

STATE OF CALIFORNIA  
FISH AND GAME COMMISSION  
INITIAL STATEMENT OF REASONS FOR REGULATORY ACTION  
(Pre-publication of Notice Statement)

Repeal Section 241 and Amend Section 245  
Title 14, California Code of Regulations  
Re: Aquaculture Disease Control Regulations

I. Date of Initial Statement of Reasons: August 7, 2008

II. Dates and Locations of Scheduled Hearings:

- (a) Notice Hearing: Date: September 4, 2008  
Location: Kings Beach, CA
- (b) Discussion Hearing: Date: October 3, 2008  
Location: Santa Rosa, CA
- (c) Adoption Hearing: Date: November 14, 2008  
Location: Huntington Beach, CA

III. Description of Regulatory Action:

- (a) Statement of Specific Purpose of Regulation Change and Factual Basis for Determining that Regulation Change is Reasonably Necessary:

The Aquaculture Disease Control Regulations have not been updated in over 20 years, except for some relatively small additions of a few shellfish diseases. New scientific information regarding the threat that certain diseases and pathogens may pose to cultured and/or wild aquatic animals needs to be reflected in the Title 14, California Code of Regulations (CCR). The Department's fish pathology staffing has been inadequate to address this issue until the recent staff additions mandated by Fish and Game Code Section 13007 and supported by the Hatchery Inland Fisheries Fund (HIFF) augmentation.

This Department proposal will repeal outdated regulations, update the diseases listings, and restructure the disease categories to reflect recent advances in fish pathology knowledge. These changes are supported by the Aquaculture Disease Committee, and the proposed revisions from current regulations are as follows:

Section 241, Title 14, CCR, prohibits the importation of salmonids produced in Idaho. It is proposed to be repealed since it is outdated and no longer applicable due to tighter disease controls in Idaho and California aquaculture disease control regulations in Title 14.

Section 245, Title 14, CCR, contains the aquaculture disease control regulations. The proposed revisions by individual subsections are outlined in the following paragraphs.

**General Conditions, subsection 245(a)**

The phrase "disease" was expanded to include both disease and pathogen to clarify the regulations.

Additional language was added to increase compliance and reduce public confusion with Department inspections of importations into the state for diseases and pathogens.

#### **Definitions, subsection 245(b)**

The definition of fish pathologist is proposed to be revised to replace virologist with veterinarian to reflect current Department staffing and include a government fish health specialist approved by the Department to clarify the regulations.

Three definitions for Disease, Pathogen, and Infection are proposed to be added to subsection 245(b) to clarify the regulations.

#### **Disease Categories, subsection 245(c)**

The phrase "disease" was expanded to include both disease and pathogen to clarify the regulations.

The categories of viruses, bacteria, parasites, fungi, and dinoflagellate algae were added to the listing of biological agents and the lists will be organized alphabetically to clarify the regulations and reduce public confusion.

The proposed revisions to each disease/pathogen list are discussed in the following paragraphs:

#### **Significant Diseases/Pathogens List, subsection 245(c)(1)**

##### **A) Proposed Deletions**

##### **GOLDEN SHINER VIRUS (GSV)**

Brief description: Aquareoviruses are typically associated with subclinical infections. They are often isolated from apparently healthy fish during routine virus screening or from fish concomitantly infected with other microbial pathogens. GSV, also known as grass carp reovirus (GCRV) and grass carp hemorrhage virus, is one of the few aquareoviruses suspected to act as a primary pathogen. The isolates from cyprinid fish, GSV/GCRV, are most often reported in association with fish kills. GSV is an aquareovirus isolated from moribund 14-16 month old cultured golden shiners, *Notemigonus crysoleucus*, in the southern U.S. during the summer of 1977. Water temperatures range between 24-30°C during this time. This virus was associated with mortality and lesions that included petechial hemorrhages in the dorsal muscle, cornea abdominal flanks, visceral fat and intestinal mucosa. Mortality is usually about 5% but under crowded conditions at high temperatures, acute mortalities of 50-75% have been observed. The virus was called GSV, but later work showed that it was phylogenetically similar to GCRV, the pathogen responsible for an acute hemorrhagic disease in grass carp, *Ctenopharyngodon idella*, in the USA and in China.

Known distribution: China, Taiwan, Malaysia, Southeastern United States, and California.

Identification of known host species and host specificity: GSV has a wide host range. Chinese grass carp reovirus produces disease in other cyprinids, including black carp *Mylopharyngodon piceus*, stone moroko *Pseudorasbora parva*, and Chinese rare minnow *Gobiocypris rarus* in China. In North America, GCRV has been isolated from moribund and healthy grass carp and golden shiners and moribund and healthy fathead minnows *Pimephales promelas* and apparently healthy wild creek chubs *Semotilus atromaculatus*. In China, GCRV has also been found in fish species where GCRV disease has never been reported. These include silver carp *Hypophthalmichthys molitrix* and the Chinese minnow *Hemiculter bleekeri*.

Description of modes of transmission: Presumed to be horizontal, water-borne.

Disease management protocols and efficacy: Avoidance due to no known treatment.

Describe why the change is warranted: GSV has been present in golden shiners and grass carp in California since at least 1989. According to Dr. Andy Goodwin of the Aquaculture/Fisheries Center at the University of Arkansas, Pine Bluff, GSV has been in California for at least 25 years. We have no documented impact on any California fish populations due to the presence of this virus.

Additional information: No literature was found that discussed the economic impacts associated with disease outbreaks or management processes. This is likely due to the limited occurrences of pathology and epizootics associated with this virus.

#### **B) Proposed Name Revisions**

OYSTER DISEASE (MSX) *Haplosporidium nelsoni*

Brief description: The causative pathogen has been renamed in the scientific literature from *Minchinia nelsoni* to *Haplosporidium nelsoni*.

Why the change is warranted: This change provides consistency with the latest scientific information.

#### OYSTER PERKINSOSIS

Brief description: The causative pathogen has been reclassified in the scientific literature from *Labyrinthomyxa marina* to *Perkinsus marinus*. In addition, the name was also changed from Oyster Fungus Disease to Oyster Perkinsosis.

Why the change is warranted: This change provides consistency with the latest scientific information.

#### SABELLID POLYCHAETE FAN WORM

Brief description: The genus and species have been described in the scientific literature as *Terebrasabella heterouncinata*, and the term “South African” was dropped from the disease description.

Why the change is warranted: This change provides consistency with the latest scientific information.

#### VIBRIOSIS *Vibrio* spp.

Brief description: *Vibrio* spp. are endemic in saltwater environments. They can cause disease with the right combination of susceptible host and poor environment. However, *Vibrio* spp. pathogenic to fish in freshwater are much less common. *Vibrio* infections in fish in freshwater have been shown to cause disease in rainbow trout, eels and ayu. Mortalities due to vibriosis in rainbow trout can reach 50%.

Why the change is warranted: There is little risk due to the introduction of saltwater *Vibrio* spp. into California. However introduction of freshwater *Vibrio* spp. could have serious impacts on the health of freshwater fish in the state.

#### **C) Proposed Additions**

##### WHITE STURGEON IRIDIOVIRUS (WSIV)

Brief description: WSIV is a lethal viral pathogen of juvenile white sturgeon, *Acipenser transmontanus*. The virus has been isolated in farm-reared white sturgeon in the Pacific Northwest of North America, California, and Canada. Currently, there is no treatment for WSIV.

Known distribution: The virus has been isolated in farmed-reared white sturgeon in the Pacific Northwest of North America, California, and Canada. Although one epidemiological survey suggested an 11% prevalence of WSIV in juvenile white sturgeon from the Columbia River, the distribution of WSIV in wild fish elsewhere remains unclear.

Identification of known host species and host specificity: White sturgeon, *Acipenser transmontanus*

Description of modes of transmission: Horizontal and vertical

Disease management protocols and efficacy: Currently, there is no treatment for WSIV. Disease management protocols must emphasize early detection and avoidance. In regards to detection, diagnosis relies primarily on histologic detection of virus-infected cells from juvenile fish. In addition, a confirmatory diagnosis can be made using virus isolation and immunostaining of tissue sections with anti-WSIV monoclonal antibodies. Polymerase chain reaction (PCR) assays have been developed and have demonstrated improved sensitivity when compared to traditional methods.

Why the change is warranted: The addition of WSIV to the significant diseases/pathogens list is warranted due to the following: 1) no treatment for WSIV; 2) distribution and prevalence of WSIV in wild fish remains unclear; 3) WSIV outbreaks in farm-reared fish will cause significant financial harm; 4) diagnostic methods, such as histologic detection, may produce false negatives, and thus limit detection capabilities.

Additional information: The lack of adequate treatments for WSIV has resulted in high mortality and massive economic losses to commercial aquaculture and considerable harm to conservation aquaculture of endangered species. In addition, WSIV poses a significant risk to wild sturgeon since the viruses may be passed by vertical transmission to progeny.

#### **Serious Diseases List, subsection 245(c)(2)**

##### **A) Proposed Deletions**

INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS (IHNV)

is proposed to move to the Catastrophic Diseases list, subsection 245(c)(3). See subsection 245(c)(3) discussion for more details.

##### **B) Proposed Name Revisions**

BONAMIASIS OF OYSTERS *Bonamia* spp.

Brief description: This is a new name for "Microcell disease of oysters". There are at least three species of *Bonamia* that cause very similar diseases in oysters. A listing of the entire genus is appropriate at this time.

Why the change is warranted: This change provides consistency with the latest scientific information.

MICROSPORIASIS *Pleistophora ovariae*

Brief description: The official name of disease has been changed to Microsporiasis.

Why the change is warranted: This change provides consistency with the latest scientific information.

PROLIFERATIVE KIDNEY DISEASE (PKD)

Brief description: The scientific name of the causative pathogen has been identified and described in the scientific literature as *Tetracapsuloides bryosalmonae*.

Why the change is warranted: This change provides consistency with the latest scientific information.

SEASIDE DISEASE *Haplosporidium costale*

Brief description: The scientific name of the causative pathogen has been renamed in the scientific literature from *Minchinia costalis* to *Haplosporidium costale*. In addition, the name was also changed from SSO to Seaside Disease.

Why the change is warranted: This change provides consistency with the latest scientific information.

### **C) Proposed Additions**

#### **KOI HERPES VIRUS (KHV)**

Brief description: KHV is a highly contagious herpesvirus and causative agent of mass mortality (often 80 to 100%) in koi (*Cyprinus carpio koi*) and common carp (*Cyprinus carpio carpio*). Koi are very popular and valuable hobby fish and common carp are the most widely cultivated food fish in the world (mainly Europe and Asia). Disease episodes occur primarily in cultured stocks but are also reported in wild populations. Outbreaks generally occur between 18 and 26°C (64-78°F). Reportedly little mortality occurs below 18°C and there are no reports of the disease occurring above 30°C. The virus is closely related to carp pox virus (Cyprinid herpesvirus 1, CHV-1) and to hematopoietic necrosis herpesvirus of goldfish (Cyprinid herpesvirus 2, CHV-2), and more distantly related to channel catfish virus (Ictalurid herpesvirus 1, IchV-1). KHV should not be confused with Spring Viremia of Carp Virus (SVCV) which is a Rhabdovirus that often occurs at much lower water temperatures. Infected fish often die soon after exposure (in one study 82% of exposed fish died within 15 days) and deaths can begin 1 to 2 days after onset of clinical sign. Virus causes many different clinical signs of disease including severely swollen and necrotic gill filaments, excessive mucus production, enophthalmos, enlarged spleen and kidney, mottled appearance of internal organs, external hemorrhaging, and abdominal adhesions. Koi herpesvirus was listed as a reportable pathogen by the International Office of Epizootics (OIE) in May of 2007. Polymerase chain reaction (PCR) of gill and brain tissue is the preferred method of detecting KHV, though serum neutralization is an option as a non-lethal test.

Known distribution: Europe (Germany, Great Britain, France, Belgium, Netherlands, Luxemburg, Italy, Denmark, Switzerland, Austria, Poland), Israel, Asia (Indonesia, Korea, China, Taiwan, Thailand, Japan), South Africa, U.S.A.

Identification of known host species and host specificity: Koi (*Cyprinus carpio koi*) and common carp (*Cyprinus carpio carpio*). Fry are more susceptible than older fish, but older fish can be infected. Goldfish (*Carassius auratus*) and grass carp (*Ctenopharyngodon idella*) seem to be resistant to infection and are not considered carriers of the virus.

Description of modes of transmission: Direct contact with infected fish/water born exposure. It is also believed that fecal material and mud can harbor active virus particles. KHV is believed to remain in infected fish for life; therefore exposed fish without clinical sign of disease should be considered carriers of the disease. International movement of live fish is suggested as the most effective means of spreading fish diseases, including KHV. International koi shows and exhibitions where fish from different origins are temporarily cohabitated (Japanese method) have further increased the risk of spreading the diseases

Disease management protocols and efficacy: Raising fish in non-permissive water temperatures (avoid temperatures between 18 and 26°C) is one option. Another practice is to expose fish to KHV (cohabitate with infected fish) and then rear newly exposed fish in non-permissive temperatures, though virus can be latent and fish showing no sign of disease can be carriers of KHV and can shed active virus thereby infecting naïve fish. Rearing fish above 30°C is touted as a viable method of preventing KHV outbreaks, but

these temperatures can lead to increased occurrence of more common bacterial and parasitic diseases. An attenuated live virus vaccine has been developed, but is yet to be proven irreversible. Facilities experiencing outbreaks should consider depopulation and disinfection of all materials and systems. Chlorine (200 ppm for 1 hour) and Quaternary ammonium chloride compounds (500 ppm for one hour) are effective disinfectants. Avoidance of the disease and quarantine of introduced fish is highly effective and suggested.

Why the change is warranted: It is warranted to limit the economic and ecological effects of this disease upon the State of California.

Additional information: Reports suggest that Israeli aquaculturists have lost an estimated \$3 million every year since 1998 due to KHV, Indonesian fish industries have lost a total of \$5.5 million since the first significant outbreaks in 2002, and common carp losses due to KHV in 2 lakes in Japan were valued at \$2.55 million.

#### LARGEMOUTH BASS VIRUS (LMBV)

Brief description: LMBV is a lethal virus of largemouth bass, *Micropterus salmoides*, specifically causing mortality in the largest ("trophy") largemouth bass in wild populations. The first reported fish kill attributed to LMBV was in 1995 and occurred in Santee-Cooper Reservoir in North Carolina and killed approximately 1,000 trophy fish. This was the first report of a systemic virus in wild centrarchids. Since then, LMBV has been reported 19 states in the Southeastern and Midwestern United States. The virus has been found in clinical and sub clinical largemouth bass, in other species of sunfish, and in both wild and hatchery populations. Largemouth bass virus was first isolated from a lake in Florida in 1991, was determined to be the cause of a fish kill in North Carolina in 1995, but was not further described until 2000. Mortality in fish kills attributed to LMBV is usually less than 10%, but always includes the largest fish of a population. Clinical signs of infected fish include darkened pigmentation, distended abdomen, spiral swimming, bloated swim bladders, inability to remain upright and general listlessness. Internally, livers are pale, spleens are bright red and intestinal ceca are reddened (hemorrhaging). The virus seems to target and cause most damage in swim bladders where often thick yellow or brown exudates can be seen. Infected fish often show no sign of disease but will test positive with polymerase chain reaction (PCR). Stressful conditions lead to LMBV disease episodes and may include warm temperatures (above 90°F), crowding, handling (even by anglers), and co-infection with other pathogens.

Known distribution: Confirmed in U.S. States of: FL, AL, AK, GA, IL, IN, KY, LA, MI, MO, MS, NC, OK, SC, TN, TX, VI, VT, WI. The DFG initiated monitoring of imported and native centrarchid fishes for viruses in 2000. No LMBV has been detected in California to date.

Identification of known host species and host specificity: Specifically produces disease in largemouth bass, though is found in other species of fish including guppies (Poeciliidae), smallmouth bass (*M. dolomieu*), Suwanee bass (*M. notius*), bluegill (*Lepomis macrochirus*), redbreasted sunfish (*L. auritus*), and white and black crappie (*Pomoxis annularis* and *P. nigromaculatus*, respectively), though only largemouth bass succumb to infection.

Description of modes of transmission: The virus can be spread through water, fish to fish contact or by largemouth bass eating infected prey species. Largemouth bass virus can persist (remain active) in water for up to 7 days and can be transferred in live wells of boats.

Disease management protocols and efficacy: Avoidance is the best policy. Fish can not be cured of LMBV and no vaccines are available. Infected populations should be maintained in the least stressful conditions as possible. Crowding, warm water temperatures, pollution, handling, and fish hauling can all lead to a disease episode in infected populations. Because other species can be carriers of LMBV (listed above), these fish should also be tested for LMBV whenever moved from an area where LMBV is known to occur. Bass fishing tournaments should be held during cooler weather and water temperatures in areas where LMBV is known to occur.

Why the change is warranted: It is warranted to avoid economic and ecological effects this virus can have on California aquaculture and sport-fishing industries. Largemouth bass is the Nation's most popular game fish and is also a species reared in California aquaculture.

Additional information: More largemouth bass have been killed annually by LMBV than by any other pathogen or environmental condition. The rapid spread of this virus through Southeastern and Midwestern U.S. states suggests that LMBV can readily be spread to California and affect wild and/or commercial populations. Outbreaks of LMBV could result in lost revenue to industries and rural communities that rely on sport fishing. Some scientists believe that the virus will only result in minor and sporadic fish kills.

#### **Catastrophic Diseases List, subsection 245(c)(3)**

##### **A) Proposed Additions**

##### **INFECTIOUS SALMON ANEMIA VIRUS (ISAV)**

Brief description: ISAV is an economically important virus causing high mortality in Atlantic salmon (*Salmo salar*) farms, though also reported in wild fish populations and other salmonid species. The virus can infect both young and adult fish. Although originally found in Norway, ISAV has now spread to other parts of Europe, Chile, eastern Canada and Maine. ISAV has not been reported in fish from the Pacific Northwest. The virus targets the vascular and hematopoietic tissues of fish resulting in severe anemia. Infectious salmon anemia was approved for emergency status by the U.S.D.A. in 2001, the first time an aquatic animal disease has been elevated to that level. First reported in Norway in 1984, ISAV has been spread to Scotland, New Brunswick and Nova Scotia, Canada, the United Kingdom, Chile, the Faroe Islands (Denmark), and the Cobscook Bay in Maine, U.S.A. Losses can be as high as 3% per day. Infected fish show clinical signs of ISAV 2 to 4 weeks after being exposed to the virus; specifically, pale gills, external hemorrhaging, ascites, exophthalmia, liver congestion, splenomegally, petechiation in visceral fat and general anemia. ISAV occurs primarily in Atlantic salmon farms but is also reported in wild Atlantic salmon in Canada. ISAV can infect herring (*Clupea* spp.), fresh and salt water brown trout (*Salmo trutta*), and rainbow trout (*Oncorhynchus mykiss*), but does not produce disease in these fish. In clinically infected fish, active virus particles can be isolated from mid- and anterior kidney, liver, spleen, intestine, gills, and skeletal and heart muscle tissues. Maximum replication of the virus occurs at 15°C (59°F), with no replication occurring at or above 25°C (77°F). Cell culture is the most accepted method of detection but Reverse Transcriptase – Polymerase Chain Reaction (RT-PCR) and monoclonal antibody assays are available and accurate.

Known distribution: Norway, Scotland, United Kingdom, eastern Canada (New Brunswick, Nova Scotia), northeastern U.S. (Maine), Chile, and the Faroe Islands.

Identification of known host species and host specificity: Produces disease in Atlantic salmon but can also infect herring and brown and rainbow trout.

Description of modes of transmission: The virus is optimally spread in the marine environment where infected individuals are cohabitated with naïve fish. ISAV is found in

urine, feces, blood, and epidermal mucus. Survivors of ISAV can shed active virus particles into water for more than one month. Experimentally infected asymptomatic smolts can infect naïve parr for up to 18 months. Nets and other equipment can transmit virus from pen to pen or farm to farm. Sea lice (copepods) can transmit ISAV from infected to naïve fish. There is evidence of vertical transmission.

Disease management protocols and efficacy: Avoidance is the best policy. European Economic Community countries require that infected stocks be depopulated. Exposed surfaces can be disinfected with sodium hypochlorite (1000 ppm for 10 hours), with iodophor (100 ppm for 10 minutes), and with chloramine-T (as per manufacturer's instructions). ISAV vaccines have been developed and are used in certain geographical areas, but none are licensed for general use.

Why the change is warranted: It is warranted to limit the effects that this virus disease can have on the California Aquaculture industry and wild salmon and trout populations.

Additional information: ISAV is reported to cause significant economic losses in affected areas. In 1999 alone, Atlantic salmon farms in Norway lost approximately \$11 million (U.S. dollars), Canadian farms lost approximately \$14 million, and farms in Scotland lost an estimated \$32 million. While there are no Atlantic salmon farms in California, ISAV is an Orthomyxovirus, closely related to influenza, suggesting it can mutate very rapidly. Furthermore, ISAV can already infect rainbow trout (*Oncorhynchus mykiss*), also suggesting potential to mutate and infect other Pacific salmon and trout species found in California.

#### ABALONE HERPESVIRUS

Brief description: A herpes(-like) virus has been associated with mass mortality of abalone in Taiwan and Australia.

Known distribution: In December 2005, epidemic mortalities began to occur in farmed and wild abalone in Victoria, Australia (*Haliotis rubra* and *H. laevis*). Dead and dying abalone were first observed at one culture facility following the acquisition of wild native broodstock from a distant location within Australia. This was followed by an outbreak at a separate facility that received animals from the first, followed by (apparently increased) mortalities in wild animals in waters adjacent to the second facility and additional spread throughout wild and cultured populations. Infected abalone were found to harbor nervous tissue lesions (ganglioneuritis) similar to those described in abalone from Taiwan

Identification of known host species and host specificity: The virus in Australia has been shown to affect *Haliotis laevis* and *H. rubra*. The isolate from Taiwan is described from *H. diversicolor*.

Description of modes of transmission: Currently unpublished studies by Australian government officials apparently demonstrated association of virus with the lesions as well as experimental transmission of the disease. The virus appeared very similar to that described in the Taiwanese abalone. The diseases in both Taiwan and Australia were characterized by extremely rapid onset with large proportions of animals dying within a few days of exposure. Viral replication in the nucleus and neurotropism were consistent with a herpesvirus taxon, and virion size and morphology were similar to a described herpesvirus of oysters.

How the outbreak came to occur at the first farm in Australia, and the relationship between the viruses in Australia and Taiwan, are currently unclear. There is some support for the idea that the virus was endemic to Australia in (some) wild populations, and the intense farm outbreaks were associated with culture stress and relatively naïve



populations. According to this scenario the outbreaks in the wild are a product of increased scrutiny and/or waves of epidemic mortality that occur from time to time. In contrast, more recent reports in the popular press suggest that highly unusual mortality epidemics are occurring and spreading in wild Australian abalone populations. The epidemics in Taiwan may have resulted from transfers of live abalone from Australia that have occurred regularly for many years.

Disease management protocols and efficacy: Avoidance is the best policy.

Why the change is warranted: Strong action to prevent introduction of this virus or set of viruses to California is warranted based on the potential susceptibility of California abalone species. If a single virus is involved, a relatively broad host range of at least three species of abalone on two continents is indicated.

Additional information: The herpesvirus was recently listed by the OIE as “Abalone Viral Mortality”. The current OIE Diagnostic Manual indicates that the chapter on this virus is in preparation.

#### **MARTEILIOIDES CHUNGMUENSIS**

Brief description: *Marteilioides chungmuensis* is a protozoan parasite that infects the cytoplasm of oocytes, causing large, tumor-like nodules resulting in loss of marketability. Prevalences higher than 40% have been reported in certain locations and seasons in both Korea and Japan. The parasite appears to invade maturing oocytes and growth is highly correlated to maturation of the host cells.

Known distribution: Korea, Japan and Australia.

Identification of known host species and host specificity: *Marteilioides chungmuensis* is a significant parasite of oysters, *Crassostrea gigas*, in Korea and Japan and *C. nippona* in Japan. Similar parasites have been described in *Crassostrea echinata* in Australia and Manila clams (*Venerupis philippinarum*) in Korea.

Description of modes of transmission: The life cycle is incompletely known although sporogonic stages are observed exclusively in oocytes. *C. gigas* placed in waters endemic for *M. chungmuensis* developed gross signs of infection within a month. Infection appears to cause delayed or failed spawning and reduced glycogen and serum protein concentrations.

Disease management protocols and efficacy: Avoidance is the best policy. The American Fisheries Society Bluebook recommends standard histopathology for diagnosis of *M. chungmuensis* although stained gonad smears, transmission electron microscopy and DNA probes can also be used.

Why the change is warranted: The Pacific oyster, *Crassostrea gigas*, is highly susceptible to this pathogen. *C. gigas* forms the basis of the California oyster culture industry and introduction of this pathogen could result in severe economic consequences.

Additional information: *Marteilioides chungmuensis* is a “Class A” shellfish disease in Washington state, a list which includes “diseases which are known to cause significant mortalities in shellfish populations, are reportable to the OIE and/or are of significant management concern (i.e. affecting trade and commerce)”. In Canada it is listed as a Category 1 disease, defined as: “Agents of infectious diseases which have not been detected in Canada, but the shellfish host species of which are found in Canada. Because these diseases can have serious impact on shellfish stocks, the disease agents responsible must be kept out of Canada.” *Marteilioides chungmuensis* is not currently

reportable to the OIE but adding it to the OIE list is the current primary objective of the OIE Mollusk Technical Work Group.

#### **SALMON RICKETTSIOSIS *Piscirickettsia salmonis***

**Brief description:** Salmon Rickettsiosis is a small Gram-negative intracellular bacteria which causes significant disease in various finfish in a number of countries around the world. It was first isolated from farmed coho salmon in Chile in 1990 using Chinook salmon embryo cell culture. North America's first diagnosed case of salmonid rickettsiosis was reported in 1992 in eastern Canada. In 1998 and 2005, epizootics in juvenile white seabass from Hubbs Seaworld in southern California were attributed to the bacterium, later confirmed by DNA analysis to be *P. salmonis*. The disease is characterized by granulomatous lesions in the spleen, kidney, intestines, heart, and gills, with the most severe lesions usually occurring in the liver.

**Known distribution:** Chile, Norway, Scotland, Ireland, and the Atlantic and Pacific coasts of Canada (salmonids); Hubbs Seaworld Research Institute facility, southern California (white seabass).

#### **Identification of known host species and host specificity: Identification of known host species and host specificity:**

Farmed Atlantic salmon (*Salmo salar*), coho salmon, (*Oncorhynchus kisutch*), steelhead/rainbow trout (*Oncorhynchus mykiss*), Chinook salmon (*Oncorhynchus tshawytscha*), pink salmon (*Oncorhynchus gorbuscha*) and masu salmon (*Oncorhynchus masou*) – all ages are susceptible. Organisms referred to as *P. salmonis*-like have been observed in white seabass (*Atractoscion nobilis*), black seabass (*Centropristis striata*), grouper (family Serranidae), three-line grunt (*Parapristipoma trilineatum*), tilapia (*Oreochromis* spp.) and blue-eyed plecostomas (*Panaque suttoni*).

**Description of modes of transmission:** Unknown. Presumed to be water-borne. Horizontal transmission occurs in saltwater and freshwater. Transmission by vectors remains a consideration.

**Disease management protocols and efficacy:** Treatment of infected pen-reared Atlantic salmon in 1996 with oxytetracycline (100 mg/kg/d) for 10 d has been associated with a decline in mortality, but the benefit seemed to have been short-lived, as the mortality increased a few weeks after treatment was stopped on two separate occasions. Florfenicol was also tried, but the fish were not eating much at the time and efficacy could not be determined. Antibiotic treatment for the disease is difficult because of the intracellular nature of the pathogen, and a vaccine has so far been ineffective due to poor immune response to whole-cell bacterins. Management protocols include those that limit disease outbreaks in general – disinfection of eggs, good husbandry techniques which minimize stressors and avoidance of organic loading from polluting sources. Disinfection of incoming water, where practical, is also an obvious advantage. No vaccines are currently available.

**Why the change is warranted:** A 2005 DFG report by pathologist Mark Okihiro summarized a disease survey, conducted between 2002 and 2005, of 94 white seabass livers tested for *P. salmonis* by PCR. There were no positives, leading him to conclude that this is an exotic disease limited to hatchery reared fish in southern California, and infected fish should be destroyed to prevent transmission to wild stocks, including commercially valuable and, in some cases, listed, salmon stocks. Cumulative mortality in experimentally infected salmonids has been observed to be 90% or more. The disease is difficult to impossible to treat, and no vaccines are available.

Additional information: In 1994, rickettsial infections were reported to have caused \$50 million in losses to the Chilean salmon industry, with losses approaching 90%. Isolates from subsequent outbreaks in other countries have not been as virulent. Experimental infections of coho with isolates originating from three different regions (Chile, British Columbia, Norway) produced mortality rates of 91, 76, and 41% respectively for similar inoculum concentrations. In another instance, an isolate obtained from hatchery-reared white seabass from southern California was injected into Atlantic salmon, Chinook salmon, and rainbow trout. Mortality rates were 100%, 62%, and 22.5%, respectively. Disease management has been limited to improving husbandry practices, or, in some cases, destruction.

INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS (IHNV) is proposed to move from the Serious Diseases list, subsection 245(c)(2).

Brief description: IHNV is an economically important virus which may cause high mortality in salmonid species. When an outbreak occurs at a fish rearing facility, there is typically high mortality in fish less than six months of age with survivors possibly becoming life-long virus carriers. The virus can infect both young and adult fish. IHNV is a negative sense single-stranded RNA virus that is a member of the Rhabdoviridae family. IHNV is commonly found in anadromous salmonids on the Pacific Coast of Canada and the USA, and has also been found in Europe and Japan. IHNV is transmitted following shedding of the virus in the feces, urine, sexual fluids, and external mucus, and from parent to progeny through the sexual fluids.

Known distribution: IHNV is known to occur along the Pacific Coast of North America and Asia, and in Europe. It has been observed in Colorado, Minnesota, Montana, New York, South Dakota, West Virginia, and Virginia, but is apparently not established in these states.

Identification of known host species and host specificity: IHNV can infect many fish species in the family Salmonidae including fish in the *Oncorhynchus*, *Salmo*, *Salvelinus* and *Thymallus* genera, but the degree to which the virus causes disease is greatly affected by the host fish, the strain of IHNV, and environmental conditions.

Description of modes of transmission: IHNV is spread by both horizontal and vertical transmission. Vertical transmission can apparently be blocked through proper disinfection of eggs.

Disease management protocols and efficacy: IHNV is not a treatable disease, so the disease is best controlled through avoidance and eradication. DNA vaccines show promise for controlling the disease, but are best delivered through IM injection, and mass delivery mechanisms have not yet been developed. As DNA vaccination is a relatively new technology, theoretical and long-term safety issues related to the environment and the consumer remain to be addressed before licensing of this type of vaccine can occur in the United States.

Why the change is warranted: With the exception of Lake Oroville, IHNV is not known to exist in inland waters of the State of California. IHNV has the potential to cause high mortality and have adverse effects on wild and domestic trout populations.

Additional information: If an aquaculture facility within the State of California were known to contain fish infected with IHNV, The Department would not allow any fish from that facility to be distributed to inland waters. IHNV has the potential to cause high mortality and have adverse effects on wild and domestic trout populations. From August 2001 to June 2003, outbreaks of IHNV occurred in 36 aquaculture operations in British Columbia.

Over 12 million Atlantic salmon on infected farms died or were culled during the epidemic with cumulative mortality on the farms averaging 58%.

SPRING VIREMIA OF CARP VIRUS (SVCV) is proposed to move from the Q Diseases list, subsection 245(c)(4).

Brief description: SVCV, *Rhabdovirus carpio*, is a rhabdovirus responsible for high mortalities primarily in cultured common carp, but it is able to produce disease in many cyprinid species. It is one of only 11 Office International des Epizootics (OIE) notifiable fish pathogens as of 2003. The virus causes disease at cool temperatures (15-20°C), which may be one reason the majority of U.S. cyprinid fish production, which takes place in the warm south, has escaped disease outbreaks and the establishment of the virus. Reports of SVCV outbreaks in wild fish are few, but have increased in recent years. Disease signs are mainly non-specific and include uncoordinated swimming, exophthalmia, ascites and petechial hemorrhaging of gills and skin.

Known distribution: Europe, western state of the former USSR, China, Middle East, Brazil, North Carolina, Washington, Missouri, wild carp in Minnesota, Wisconsin and Illinois, shrimp in Hawaii.

Identification of known host species and host specificity: Common carp (*Cyprinus carpio*), koi carp (*Cyprinus carpio carpio*), grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Hypophthalmichthys nobilis*), crucian carp (*Carassius carassius*), goldfish (*Carassius auratus*), tench (*Tinca tinca*), orfe (*Leuciscus idus*), and European catfish (*Silurus glanis*). Very young pike (*Esox lucius*) and perch (*Perca sp.*) are also susceptible, and experimentally infected fish include roach (*Rutilus rutilus*), zebra fish (*Danio rerio*), guppies (*Poecilia reticulata*), northern pike (*Esox lucius*), golden shiners (*Notemogonus crysoleucas*), and pumpkinseed (*Lepomis gibbosus*). An SVCV-like virus has been isolated from diseased cultured shrimp. Common carp (particularly yearlings) are the most susceptible and considered the principal host.

Description of modes of transmission: Transmission can occur from clinically sick fish, as well as asymptomatic carriers. The virus is shed in the feces, urine, and gill and skin mucus. Fish are infected through water or direct contact, most often through the gills. Vertical transmission has not been ruled out as the virus has also been found in ovarian fluids. Blood-sucking parasites, including leeches and fish lice have been implicated in spreading the virus, and mechanical transmission via birds and equipment is suspected because the virus is long-lived in mud, water, and following desiccation.

Identify disease management protocols and efficacy: SVCV can likely be controlled through surveillance and strict biosecurity measures, including monitoring of importations and separate show-tanks during competitive koi shows. Temperature manipulation may be the most practical way of preventing or controlling mortality if an epizootic is in progress. Maintaining water temperature above 20°C (68°F) may prevent an outbreak. Most efforts during active outbreaks are directed at depopulation and disinfection. The virus can be inactivated by formalin, ozone, iodophor, UV radiation, chlorine (500 ppm for 10 minutes), pH of less than 4.0 or greater than 10.0, and temperatures of 60°C (140°F) for 15 minutes. Disinfection of natural ponds is difficult because the virus can be remain infectious in mud and water for up to 42 days. Fish husbandry practices that limit stressors such as crowding, handling, poor water quality, and sudden temperature changes will make fish less susceptible to the virus. An injectable vaccine is being developed, but none are available at this time.

Describe why the change is warranted: SVCV can cause high mortality in both common carp and ornamental koi, and a number of cyprinid and other species can also become infected. Many species have the potential to be carriers and the extent of potential

impacts to aquaculture, private ponds, and wild fish are unknown. The epizootic in Cedar Lake, Wisconsin in 2002 killed approximately 1,500 carp, or 20% of the population. No vaccine is currently available. It has been suggested that outbreaks of SVCV in mature fish can be prevented or halted by raising water temperatures to above 20°C (68°F), however, results of such manipulations have not been well documented, and depopulation is recommended due to the severity of the disease.

Additional information: The disease outbreak in common carp from Cedar Lake, Wisconsin, killed an estimated 10 tons of fish. Morbidity and mortality rates vary with stress factors and population density, species, age, water temperature, and condition of fish. Mortality rates up to 70% have been reported in young carp during epizootics, and experimentally infected fish mortality rates can reach 90%. Losses in older fish during a season are usually 30%. It is a systemic, acute and highly contagious disease. SVCV was confirmed in ornamental koi carp in Pike County, Missouri on July 13, 2004. The outbreak occurred after introduction of koi in June 2004. Mortality of approximately 70 percent of 500 fish occurred in the two weeks following shipment.

#### **B) Proposed Name Revisions**

##### **INFECTIOUS PANCREATIC NECROSIS VIRUS (IPNV)**

Brief description: Virus is proposed to be added to the name to identify help it as a virus.

Why the change is warranted: This change provides consistency with the latest scientific information.

##### **CHANNEL CATFISH VIRUS (CCV).**

Brief description: Disease is proposed to be removed from the name to identify help it as a virus.

Why the change is warranted: This change provides consistency with the latest scientific information.

##### **VIRAL HEMORRHAGIC SEPTICEMIA VIRUS (VHSV)**

Brief description: Egtved is proposed to be removed from the name as current literature no longer includes the town where the virus was first discovered.

Why the change is warranted: This change provides consistency with the latest scientific information.

#### **Q Diseases List, subsections 245(c)(4)**

##### **A) Proposed Deletions**

##### **SPRING VIREMIA OF CARP VIRUS (SVCV)**

Is proposed to move to the Catastrophic Diseases list, subsection 245(c)(3). See subsection 245(c)(3) discussion for more details.

##### **B) Proposed Name Revisions**

##### **DENMAN ISLAND DISEASE *Mikrocytos mackini***

Brief description: The scientific name of the causative pathogen has been described in the scientific literature as *Mikrocytos mackini*.

Why the change is warranted: This change provides consistency with the latest scientific information.

##### **VIRAL ERYTHROCYTIC NECROSIS VIRUS (VENV)**

Brief description: Virus is proposed to be added to the name to identify help it as a virus.

Why the change is warranted: This change provides consistency with the latest scientific information.

**Aquatic Diseases and Organisms Lists, subsection 245(d)**

The list of diseases/pathogens and the affected aquatic plants and animals in this subsection are updated to reflect the revisions proposed for subsection 245(c).

Additional minor changes to the subsection of Section 245 are proposed to clarify the regulations and reduce public confusion.

- (b) Authority and Reference Sections from Fish and Game Code for Regulation:

Authority: Sections 200, 15500, 15510 and 15504, Fish and Game Code.

Reference: Sections 15500, 15504, 15505, 15508, 15509 and 15510, Fish and Game Code.

- (c) Specific Technology or Equipment Required by Regulatory Change:

None.

- (d) Identification of Reports or Documents Supporting Regulation Change:

None

- (e) Public Discussions of Proposed Regulations Prior to Notice Publication:

No public meetings are being held prior to the notice publication. The 45- day comment period provides adequate time for review of the proposed amendments.

IV. Description of Reasonable Alternatives to Regulatory Action:

- (a) Alternatives to Regulation Change:

No alternatives were identified.

- (b) No Change Alternative:

The present list of diseases and pathogens will not reflect new scientific information and therefore not effectively control new threats to cultured and/or wild aquatic animals.

- (c) Consideration of Alternatives:

In view of information currently possessed, no reasonable alternative considered would be more effective in carrying out the purposes for which the regulation is proposed or would as effective and less burdensome to the affected private persons than the proposed regulation.

V. Mitigation Measures Required by Regulatory Action:

The proposed regulatory action will have no negative impact on the environment; therefore, no mitigation measures are needed.

VI. Impact of Regulatory Action:

The potential for significant statewide adverse economic impacts that might result from the proposed regulatory action has been assessed, and the following initial determinations relative to the required statutory categories have been made:

- (a) Significant Statewide Adverse Economic Impact Directly Affecting Businesses, Including the Ability of California Businesses to Compete with Businesses in Other States:

The proposed action will not have a significant statewide adverse economic impact directly affecting business, including the ability of California businesses to compete with businesses in other states. The proposed changes are necessary to effectively control threats to cultured and/or wild aquatic animals from diseases and pathogens and therefore the prevention of adverse economic impacts.

- (b) Impact on the Creation or Elimination of Jobs Within the State, the Creation of New Businesses or the Elimination of Existing Businesses, or the Expansion of Businesses in California:

None.

- (c) Cost Impacts on a Representative Private Person or Business:

The agency is not aware of any cost impacts that a representative private person or business would necessarily incur in reasonable compliance with the proposed action.

- (d) Costs or Savings to State Agencies or Costs/Savings in Federal Funding to the State:

None.

- (e) Nondiscretionary Costs/Savings to Local Agencies:

None.

- (f) Programs Mandated on Local Agencies or School Districts:

None.

- (g) Costs Imposed on Any Local Agency or School District that is Required to be Reimbursed Under Part 7 (commencing with Section 17500) of Division 4:

None.

- (h) Effect on Housing Costs:

None.

## **Informative Digest/Policy Statement Overview**

The Aquaculture Disease Control Regulations have not been updated in over 20 years, except for some relatively small additions of a few shellfish diseases. New scientific information regarding the threat that certain diseases and pathogens may pose to cultured and/or wild aquatic animals needs to be reflected in the Title 14, California Code of Regulations (CCR). The Department's fish pathology staffing has been inadequate to address this issue until the recent staff additions mandated by Fish and Game Code Section 13007 and supported by the Hatchery Inland Fisheries Fund (HIFF) augmentation.

This Department proposal will repeal outdated regulations, update the diseases listings, and restructure the disease categories to reflect recent advances in fish pathology knowledge. These changes are supported by the Aquaculture Disease Committee, and the proposed revisions from current regulations are as follows:

Section 241, Title 14, CCR, prohibits the importation of salmonids produced in Idaho. It is proposed to be repealed since it is outdated and no longer applicable due to tighter disease controls in Idaho and California aquaculture disease control regulations in Title 14.

Section 245, Title 14, CCR, contains the aquaculture disease control regulations. The proposed revisions by individual subsections are outlined in the following paragraphs.

### **General Conditions, subsection 245(a)**

The phrase "disease" was expanded to include both disease and pathogen to clarify the regulations.

Additional language was added to increase compliance and reduce public confusion with Department inspections of importations into the state for diseases and pathogens.

### **Definitions, subsection 245(b)**

The definition of fish pathologist is proposed to be revised to replace virologist with veterinarian to reflect current Department staffing and include a government fish health specialist approved by the Department to clarify the regulations.

Three definitions for Disease, Pathogen, and Infection are proposed to be added to subsection 245(b) to clarify the regulations.

### **Disease Categories, subsection 245(c)**

The phrase "disease" was expanded to include both disease and pathogen to clarify the regulations.

The categories of viruses, bacteria, parasites, fungi, and dinoflagellate algae were added to the listing of biological agents and the lists will be organized alphabetically to clarify the regulations and reduce public confusion.

The proposed revisions to each disease/pathogen list are discussed in the following paragraphs:

### **Significant Diseases/Pathogens List, subsection 245(c)(1)**

#### **A) Proposed Deletions**

##### **GOLDEN SHINER VIRUS (GSV)**

**Brief description:** Aquareoviruses are typically associated with subclinical infections. They are often isolated from apparently healthy fish during routine virus screening or from fish concomitantly infected with other microbial pathogens. GSV, also known as grass carp reovirus (GCRV) and grass carp hemorrhage virus, is one of the few aquareoviruses suspected to act as a primary pathogen. The isolates from cyprinid fish, GSV/GCRV, are most often reported in association with fish kills. GSV is an aquareovirus isolated from moribund 14-16 month old cultured golden shiners, *Notemigonus crysoleucus*, in the southern U.S. during the summer of 1977. Water temperatures range between 24-30°C during this time. This virus was associated with mortality and lesions that included petechial hemorrhages in the



dorsal muscle, cornea abdominal flanks, visceral fat and intestinal mucosa. Mortality is usually about 5% but under crowded conditions at high temperatures, acute mortalities of 50-75% have been observed. The virus was called GSV, but later work showed that it was phylogenetically similar to GCRV, the pathogen responsible for an acute hemorrhagic disease in grass carp, *Ctenopharyngodon idella*, in the USA and in China.

Describe why the change is warranted: GSV has been present in golden shiners and grass carp in California since at least 1989. According to Dr. Andy Goodwin of the Aquaculture/Fisheries Center at the University of Arkansas, Pine Bluff, GSV has been in California for at least 25 years. We have no documented impact on any California fish populations due to the presence of this virus.

Additional information: No literature was found that discussed the economic impacts associated with disease outbreaks or management processes. This is likely due to the limited occurrences of pathology and epizootics associated with this virus.

## **B) Proposed Name Revisions**

OYSTER DISEASE (MSX) *Haplosporidium nelsoni*

Brief description: The causative pathogen has been renamed in the scientific literature from *Minchinia nelsoni* to *Haplosporidium nelsoni*.

Why the change is warranted: This change provides consistency with the latest scientific information.

## OYSTER PERKINSOSIS

Brief description: The causative pathogen has been reclassified in the scientific literature from *Labyrinthomyxa marina* to *Perkinsus marinus*. In addition, the name was also changed from Oyster Fungus Disease to Oyster Perkinsosis.

Why the change is warranted: This change provides consistency with the latest scientific information.

## SABELLID POLYCHAETE FAN WORM

Brief description: The genus and species have been described in the scientific literature as *Terebrasabella heterouncinata*, and the term “South African” was dropped from the disease description.

Why the change is warranted: This change provides consistency with the latest scientific information.

## VIBRIOSIS *Vibrio* spp.

Brief description: *Vibrio* spp. are endemic in saltwater environments. They can cause disease with the right combination of susceptible host and poor environment. However, *Vibrio* spp. pathogenic to fish in freshwater are much less common. *Vibrio* infections in fish in freshwater have been shown to cause disease in rainbow trout, eels and ayu. Mortalities due to vibriosis in rainbow trout can reach 50%.

Why the change is warranted: There is little risk due to the introduction of saltwater *Vibrio* spp. into California. However introduction of freshwater *Vibrio* spp. could have serious impacts on the health of freshwater fish in the state.

## **C) Proposed Additions**

### WHITE STURGEON IRIDIOVIRUS (WSIV)

Brief description: WSIV is a lethal viral pathogen of juvenile white sturgeon, *Acipenser transmontanus*. The virus has been isolated in farm-reared white sturgeon in the Pacific Northwest of North America, California, and Canada. Currently, there is no treatment for WSIV.

Why the change is warranted: The addition of WSIV to the significant diseases/pathogens list is warranted due to the following: 1) no treatment for WSIV; 2) distribution and prevalence of WSIV in wild fish remains unclear; 3) WSIV outbreaks in farm-reared fish will cause significant financial harm; 4)

diagnostic methods, such as histologic detection, may produce false negatives, and thus limit detection capabilities.

Additional information: The lack of adequate treatments for WSIV has resulted in high mortality and massive economic losses to commercial aquaculture and considerable harm to conservation aquaculture of endangered species. In addition, WSIV poses a significant risk to wild sturgeon since the viruses may be passed by vertical transmission to progeny.

#### **Serious Diseases List, subsection 245(c)(2)**

##### **A) Proposed Deletions**

###### **INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS (IHNV)**

is proposed to move to the Catastrophic Diseases list, subsection 245(c)(3). See subsection 245(c)(3) discussion for more details.

##### **B) Proposed Name Revisions**

###### **BONAMIASIS OF OYSTERS *Bonamia* spp.**

Brief description: This is a new name for “Microcell disease of oysters”. There are at least three species of *Bonamia* that cause very similar diseases in oysters. A listing of the entire genus is appropriate at this time.

Why the change is warranted: This change provides consistency with the latest scientific information.

###### **MICROSPORIASIS *Pleistophora ovariae***

Brief description: The official name of disease has been changed to Microsporiasis.

Why the change is warranted: This change provides consistency with the latest scientific information.

###### **PROLIFERATIVE KIDNEY DISEASE (PKD)**

Brief description: The scientific name of the causative pathogen has been identified and described in the scientific literature as *Tetracapsuloides bryosalmonae*.

Why the change is warranted: This change provides consistency with the latest scientific information.

###### **SEASIDE DISEASE *Haplosporidium costale***

Brief description: The scientific name of the causative pathogen has been renamed in the scientific literature from *Minchinia costalis* to *Haplosporidium costale*. In addition, the name was also changed from SSO to Seaside Disease.

Why the change is warranted: This change provides consistency with the latest scientific information.

##### **C) Proposed Additions**

###### **KOI HERPES VIRUS (KHV)**

Brief description: KHV is a highly contagious herpesvirus and causative agent of mass mortality (often 80 to 100%) in koi (*Cyprinus carpio koi*) and common carp (*Cyprinus carpio carpio*). Koi are very popular and valuable hobby fish and common carp are the most widely cultivated food fish in the world (mainly Europe and Asia). Disease episodes occur primarily in cultured stocks but are also reported in wild populations. Outbreaks generally occur between 18 and 26°C (64-78°F). Reportedly little mortality occurs below 18°C and there are no reports of the disease occurring above 30°C. The virus is closely related to carp pox virus (Cyprinid herpesvirus 1, CHV-1) and to hematopoietic necrosis herpesvirus of goldfish (Cyprinid herpesvirus 2, CHV-2), and more distantly related to channel catfish virus (Ictalurid herpesvirus 1, ICHV-1). KHV should not be confused with Spring Viremia of Carp Virus (SVCV) which is a Rhabdovirus that often occurs at much lower water temperatures. Infected fish often die soon after exposure (in one study 82% of exposed fish died within 15 days) and deaths can begin 1 to 2 days after onset of clinical sign. Virus causes many different clinical signs of disease including severely swollen and necrotic gill filaments, excessive mucus production, enophthalmos, enlarged spleen and kidney, mottled appearance of internal organs, external hemorrhaging, and abdominal adhesions. Koi herpesvirus was listed as a reportable pathogen by the International Office of Epizootics (OIE) in May of 2007.

Polymerase chain reaction (PCR) of gill and brain tissue is the preferred method of detecting KHV, though serum neutralization is an option as a non-lethal test.

Why the change is warranted: It is warranted to limit the economic and ecological effects of this disease upon the State of California.

Additional information: Reports suggest that Israeli aquaculturists have lost an estimated \$3 million every year since 1998 due to KHV, Indonesian fish industries have lost a total of \$5.5 million since the first significant outbreaks in 2002, and common carp losses due to KHV in 2 lakes in Japan were valued at \$2.55 million.

#### LARGEMOUTH BASS VIRUS (LMBV)

Brief description: LMBV is a lethal virus of largemouth bass, *Micropterus salmoides*, specifically causing mortality in the largest ("trophy") largemouth bass in wild populations. The first reported fish kill attributed to LMBV was in 1995 and occurred in Santee-Cooper Reservoir in North Carolina and killed approximately 1,000 trophy fish. This was the first report of a systemic virus in wild centrarchids. Since then, LMBV has been reported 19 states in the Southeastern and Midwestern United States. The virus has been found in clinical and sub clinical largemouth bass, in other species of sunfish, and in both wild and hatchery populations. Largemouth bass virus was first isolated from a lake in Florida in 1991, was determined to be the cause of a fish kill in North Carolina in 1995, but was not further described until 2000. Mortality in fish kills attributed to LMBV is usually less than 10%, but always includes the largest fish of a population. Clinical signs of infected fish include darkened pigmentation, distended abdomen, spiral swimming, bloated swim bladders, inability to remain upright and general listlessness. Internally, livers are pale, spleens are bright red and intestinal ceca are reddened (hemorrhaging). The virus seems to target and cause most damage in swim bladders where often thick yellow or brown exudates can be seen. Infected fish often show no sign of disease but will test positive with polymerase chain reaction (PCR). Stressful conditions lead to LMBV disease episodes and may include warm temperatures (above 90°F), crowding, handling (even by anglers), and co-infection with other pathogens.

Why the change is warranted: It is warranted to avoid economic and ecological effects this virus can have on California aquaculture and sport-fishing industries. Largemouth bass is the Nation's most popular game fish and is also a species reared in California aquaculture.

Additional information: More largemouth bass have been killed annually by LMBV than by any other pathogen or environmental condition. The rapid spread of this virus through Southeastern and Midwestern U.S. states suggests that LMBV can readily be spread to California and affect wild and/or commercial populations. Outbreaks of LMBV could result in lost revenue to industries and rural communities that rely on sport fishing. Some scientists believe that the virus will only result in minor and sporadic fish kills.

#### **Catastrophic Diseases List, subsection 245(c)(3)**

##### **A) Proposed Additions**

##### **INFECTIOUS SALMON ANEMIA (ISAV)**

Brief description: ISAV is an economically important virus causing high mortality in Atlantic salmon (*Salmo salar*) farms, though also reported in wild fish populations and other salmonid species. The virus can infect both young and adult fish. Although originally found in Norway, ISAV has now spread to other parts of Europe, Chile, eastern Canada and Maine. ISAV has not been reported in fish from the Pacific Northwest. The virus targets the vascular and hematopoietic tissues of fish resulting in severe anemia. Infectious salmon anemia was approved for emergency status by the U.S.D.A. in 2001, the first time an aquatic animal disease has been elevated to that level. First reported in Norway in 1984, ISAV has been spread to Scotland, New Brunswick and Nova Scotia, Canada, the United Kingdom, Chile, the Faroe Islands (Denmark), and the Cobscook Bay in Maine, U.S.A. Losses can be as high as 3% per day. Infected fish show clinical signs of ISAV 2 to 4 weeks after being exposed to the virus; specifically, pale gills, external hemorrhaging, ascites, exophthalmia, liver congestion, splenomegaly, petechiation in visceral fat and general anemia. ISAV occurs primarily in Atlantic salmon farms but is also reported in

wild Atlantic salmon in Canada. ISAV can infect herring (*Clupea* spp.), fresh and salt water brown trout (*Salmo trutta*), and rainbow trout (*Oncorhynchus mykiss*), but does not produce disease in these fish. In clinically infected fish, active virus particles can be isolated from mid- and anterior kidney, liver, spleen, intestine, gills, and skeletal and heart muscle tissues. Maximum replication of the virus occurs at 15°C (59°F), with no replication occurring at or above 25°C (77°F). Cell culture is the most accepted method of detection but Reverse Transcriptase – Polymerase Chain Reaction (RT-PCR) and monoclonal antibody assays are available and accurate.

Why the change is warranted: It is warranted to limit the effects that this virus disease can have on the California Aquaculture industry and wild salmon and trout populations.

Additional information: ISAV is reported to cause significant economic losses in affected areas. In 1999 alone, Atlantic salmon farms in Norway lost approximately \$11 million (U.S. dollars), Canadian farms lost approximately \$14 million, and farms in Scotland lost an estimated \$32 million. While there are no Atlantic salmon farms in California, ISAV is an Orthomyxovirus, closely related to influenza, suggesting it can mutate very rapidly. Furthermore, ISAV can already infect rainbow trout (*Oncorhynchus mykiss*), also suggesting potential to mutate and infect other Pacific salmon and trout species found in California.

#### ABALONE HERPESVIRUS

Brief description: A herpes(-like) virus has been associated with mass mortality of abalone in Taiwan and Australia.

Known distribution: In December 2005, epidemic mortalities began to occur in farmed and wild abalone in Victoria, Australia (*Haliotis rubra* and *H. laevis*). Dead and dying abalone were first observed at one culture facility following the acquisition of wild native broodstock from a distant location within Australia. This was followed by an outbreak at a separate facility that received animals from the first, followed by (apparently increased) mortalities in wild animals in waters adjacent to the second facility and additional spread throughout wild and cultured populations. Infected abalone were found to harbor nervous tissue lesions (ganglioneuritis) similar to those described in abalone from Taiwan.

Why the change is warranted: Strong action to prevent introduction of this virus or set of viruses to California is warranted based on the potential susceptibility of California abalone species. If a single virus is involved, a relatively broad host range of at least three species of abalone on two continents is indicated.

Additional information: The herpesvirus was recently listed by the OIE as “Abalone Viral Mortality”. The current OIE Diagnostic Manual indicates that the chapter on this virus is in preparation.

#### MARTEILIOIDES CHUNGMUENSIS

Brief description: *Marteilioides chungmuensis* is a protozoan parasite that infects the cytoplasm of oocytes, causing large, tumor-like nodules resulting in loss of marketability. Prevalences higher than 40% have been reported in certain locations and seasons in both Korea and Japan. The parasite appears to invade maturing oocytes and growth is highly correlated to maturation of the host cells.

Why the change is warranted: The Pacific oyster, *Crassostrea gigas*, is highly susceptible to this pathogen. *C. gigas* forms the basis of the California oyster culture industry and introduction of this pathogen could result in severe economic consequences.

Additional information: *Marteilioides chungmuensis* is a “Class A” shellfish disease in Washington state, a list which includes “diseases which are known to cause significant mortalities in shellfish populations, are reportable to the OIE and/or are of significant management concern (i.e. affecting trade and commerce)”. In Canada it is listed as a Category 1 disease, defined as: “Agents of infectious diseases which have not been detected in Canada, but the shellfish host species of which are found in Canada. Because these diseases can have serious impact on shellfish stocks, the disease agents responsible must be kept out of

Canada.” *Marteilioides chungmuensis* is not currently reportable to the OIE but adding it to the OIE list is the current primary objective of the OIE Mollusk Technical Work Group.

#### **SALMON RICKETTSIOSIS *Piscirickettsia salmonis***

Brief description: Salmon Rickettsiosis is a small Gram-negative intracellular bacteria which causes significant disease in various finfish in a number of countries around the world. It was first isolated from farmed coho salmon in Chile in 1990 using Chinook salmon embryo cell culture. North America's first diagnosed case of salmonid rickettsiosis was reported in 1992 in eastern Canada. In 1998 and 2005, epizootics in juvenile white seabass from Hubbs Seaworld in southern California were attributed to the bacterium, later confirmed by DNA analysis to be *P. salmonis*. The disease is characterized by granulomatous lesions in the spleen, kidney, intestines, heart, and gills, with the most severe lesions usually occurring in the liver.

Why the change is warranted: A 2005 DFG report by pathologist Mark Okihiro summarized a disease survey, conducted between 2002 and 2005, of 94 white seabass livers tested for *P. salmonis* by PCR. There were no positives, leading him to conclude that this is an exotic disease limited to hatchery reared fish in southern California, and infected fish should be destroyed to prevent transmission to wild stocks, including commercially valuable and, in some cases, listed, salmon stocks. Cumulative mortality in experimentally infected salmonids has been observed to be 90% or more. The disease is difficult to impossible to treat, and no vaccines are available.

Additional information: In 1994, rickettsial infections were reported to have caused \$50 million in losses to the Chilean salmon industry, with losses approaching 90%. Isolates from subsequent outbreaks in other countries have not been as virulent. Experimental infections of coho with isolates originating from three different regions (Chile, British Columbia, Norway) produced mortality rates of 91, 76, and 41% respectively for similar inoculum concentrations. In another instance, an isolate obtained from hatchery-reared white seabass from southern California was injected into Atlantic salmon, Chinook salmon, and rainbow trout. Mortality rates were 100%, 62%, and 22.5%, respectively. Disease management has been limited to improving husbandry practices, or, in some cases, destruction.

**INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS (IHNV)** is proposed to move from the Serious Diseases list, subsection 245(c)(2).

Brief description: IHNV is an economically important virus which may cause high mortality in salmonid species. When an outbreak occurs at a fish rearing facility, there is typically high mortality in fish less than six months of age with survivors possibly becoming life-long virus carriers. The virus can infect both young and adult fish. IHNV is a negative sense single-stranded RNA virus that is a member of the Rhabdoviridae family. IHNV is commonly found in anadromous salmonids on the Pacific Coast of Canada and the USA, and has also been found in Europe and Japan. IHNV is transmitted following shedding of the virus in the feces, urine, sexual fluids, and external mucus, and from parent to progeny through the sexual fluids.

Why the change is warranted: With the exception of Lake Oroville, IHNV is not known to exist in inland waters of the State of California. IHNV has the potential to cause high mortality and have adverse effects on wild and domestic trout populations.

Additional information: If an aquaculture facility within the State of California were known to contain fish infected with IHNV, The Department would not allow any fish from that facility to be distributed to inland waters. IHNV has the potential to cause high mortality and have adverse effects on wild and domestic trout populations. From August 2001 to June 2003, outbreaks of IHNV occurred in 36 aquaculture operations in British Columbia. Over 12 million Atlantic salmon on infected farms died or were culled during the epidemic with cumulative mortality on the farms averaging 58%.

**SPRING VIREMIA OF CARP VIRUS (SVCV)** is proposed to move from the Q Diseases list, subsection 245(c)(4).

Brief description: SVCV, *Rhabdovirus carpio*, is a rhabdovirus responsible for high mortalities primarily in cultured common carp, but it is able to produce disease in many cyprinid species. It is one of only 11 Office International des Epizootics (OIE) notifiable fish pathogens as of 2003. The virus causes disease at cool temperatures (15-20°C), which may be one reason the majority of U.S. cyprinid fish production, which takes place in the warm south, has escaped disease outbreaks and the establishment of the virus. Reports of SVCV outbreaks in wild fish are few, but have increased in recent years. Disease signs are mainly non-specific and include uncoordinated swimming, exophthalmia, ascites and petechial hemorrhaging of gills and skin.

Describe why the change is warranted: SVCV can cause high mortality in both common carp and ornamental koi, and a number of cyprinid and other species can also become infected. Many species have the potential to be carriers and the extent of potential impacts to aquaculture, private ponds, and wild fish are unknown. The epizootic in Cedar Lake, Wisconsin in 2002 killed approximately 1,500 carp, or 20% of the population. No vaccine is currently available. It has been suggested that outbreaks of SVCV in mature fish can be prevented or halted by raising water temperatures to above 20°C (68°F), however, results of such manipulations have not been well documented, and depopulation is recommended due to the severity of the disease.

Additional information: The disease outbreak in common carp from Cedar Lake, Wisconsin, killed an estimated 10 tons of fish. Morbidity and mortality rates vary with stress factors and population density, species, age, water temperature, and condition of fish. Mortality rates up to 70% have been reported in young carp during epizootics, and experimentally infected fish mortality rates can reach 90%. Losses in older fish during a season are usually 30%. It is a systemic, acute and highly contagious disease. SVCV was confirmed in ornamental koi carp in Pike County, Missouri on July 13, 2004. The outbreak occurred after introduction of koi in June 2004. Mortality of approximately 70 percent of 500 fish occurred in the two weeks following shipment.

#### **B) Proposed Name Revisions**

INFECTIOUS PANCREATIC NECROSIS VIRUS (IPNV)

Brief description: Virus is proposed to be added to the name to identify help it as a virus.

Why the change is warranted: This change provides consistency with the latest scientific information.

CHANNEL CATFISH VIRUS (CCV).

Brief description: Disease is proposed to be removed from to identify help it as a virus.

Why the change is warranted: This change provides consistency with the latest scientific information.

VIRAL HEMORRHAGIC SEPTICEMIA VIRUS (VHSV)

Brief description: Egtved is proposed to be removed from the name as current literature no longer includes the town where the virus was first discovered.

Why the change is warranted: This change provides consistency with the latest scientific information.

#### **Q Diseases List, subsections 245(c)(4)**

##### **A) Proposed Deletions**

SPRING VIREMIA OF CARP VIRUS (SVCV)

Is proposed to move to the Catastrophic Diseases list, subsection 245(c)(3). See subsection 245(c)(3) discussion for more details.

##### **B) Proposed Name Revisions**

DENMAN ISLAND DISEASE *Mikrocytos mackini*

Brief description: The scientific name of the causative pathogen has been described in the scientific literature as *Mikrocytos mackini*.

Why the change is warranted: This change provides consistency with the latest scientific information.

VIRAL ERYTHROCYTIC NECROSIS VIRUS (VENV)

Brief description: Virus is proposed to be added to the name to identify help it as a virus.

Why the change is warranted: This change provides consistency with the latest scientific information.

**Aquatic Diseases and Organisms Lists, subsection 245(d)**

The list of diseases/pathogens and the affected aquatic plants and animals in this subsection are updated to reflect the revisions proposed for subsection 245(c).

Additional minor changes to the subsection of Section 245 are proposed to clarify the regulations and reduce public confusion.